Computer Graphics
CMPT 460.3/837.3

University of Saskatchewan

Final Examination (Closed Book)

Instructor: *Herbert Yang*
Date: December 17, 1991
Total Marks: 140
Time Allowed: 180 minutes

Answer all questions. Read each question carefully and budget your time. The marks do not necessarily reflect the difficulty of the question. Use your judgement. Write neatly and clearly.

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1. (20 marks - 5 marks to each topic)

   Select and discuss four of the following projects presented in the Graphics class. You should emphasize on the interesting features of the projects and not on the details.

   Note: You are not allowed to select your own project.

   (a) Liu, Jen,"Colour objects modelling using ray tracing."

   (b) Wu, Zhanhong, "Improved automatic tension adjustment for interpolatory splines."

   (c) Andres, Nolan and Jacob Wickland, "Parallel implementation of Bresenham's line and circle algorithms."

   (d) Chen, Xin, "Implementation of a new hidden line removal algorithm."

   (e) Bailey, Ken and Lorene Turner, "An analysis of new algorithms for line clipping and parametric line clipping."

   (f) Li, Weidong, "Fractal surface generation."

(g) Fehdran, Brian, "Two bit/pixel full colour encoding."

(h) Zhu, Jiabi, "On shadow algorithms."

(i) Muller, Stacey and Shawn Switenky, "A command language and animation system for the human-like movement of a stick figure."

(j) Fortugno, Jim, "Application of interval mathematics to graphics algorithms."

(k) Wang, Yuebiao, "A midpoint tracking algorithm for algebraic curves."

(l) Salahub, Brett and Kelly Campbell, "Line drawing using recursive bisection."

(m) Liu, Heng, "Fast ray tracing algorithm: implementation and evaluation."

(n) Reid, Karen, "Extending and improving an implementation of L-systems."

(o) Friesen, Darryl and Paul Chan, "Line algorithms for raster displays rescued from round-off errors."

(p) Lemke, Brendan and James Giesbrecht, "3-D function plotting in three coordinate systems."

(q) Punshon, John and S. Bakshi, "Recursive bisection line algorithm."

(r) Kalhan, Ajay, "Volume rendering using ray tracing of ultrasound images."

(s) Froehlich, Gary and Richard Millham, "Comparison of three ellipse-drawing algorithms."

2. (20 marks)

The following line algorithm generates dotted lines at one point every n steps. The slope of the line is assumed to be less than 1 and the line is assumed to go through the origin. Use program transformation to convert the following algorithm to one that does **not** require floating point arithmetics. You should show and explain all your steps in details.

```
var yt: real; dx, dy, xi, yi, n: integer
for xi:= 0 to dx by n do
begin
yt := [dy/dx]*xi;
yi := trunc(yt+1/2);
display(xi,yi);
end
```

3. (20 marks)

   Derive the double step incremental algorithm for generating lines with slope in the range of 0 and 1.

4. (20 marks)

   Derive all the required equations for ray-tracing a cylinder of finite length. Terms used in your derivation should be defined and explained clearly.

5. (20 marks)

   Give a detailed description of the Floyd-Steinberg error diffusion algorithm and the dot-diffusion algorithm in half-toning. You should emphasize on the principles rather than on the details. Discuss their advantages and disadvantages.

6. (20 marks - (i) 5 marks (ii) 5 marks (iii) 10 marks)

   (i) Define perspective projection.

   (ii) Derive the projection matrix used in computer graphics.

   (iii) Explain mathematically the reason why parallel lines in three dimensions appear to meet at a point called the vanishing point on the projection plane if the perspective projection is used.

7. (20 marks - (i) 5 marks (ii) 5 marks (iii) 10 marks)

   (i) Explain the differences between interpolation and approximation in the context of curve fitting.

   (ii) What is a Bezier curve?

   (iii) Derive its recursive property mathematically (i.e. a Bezier curve with n points is a linear combination of two Bezier curves of n-1 points.).